COVENIENT AND SMART WOUND SCANNER

TEH MUN YEE

THIS DISSERTATION IS SUBMITTED AS A PARTIAL REQUIREMENT TO OBTAIN
DEGREE OF BACHELOR OF SCIENCE WITH HONOURS

PERPUStAKAAN
UNIVERSITI MALAYSIA SABA~

PHYSICS WITH ELECTRONICS PROGRAMME
FACULTY OF SCIENCE AND NATURAL RESOURCES
UNIVERSITY MALAYSIA SABAH

2015
JUDUL: CONVENIENT AND SMART WOUND SCANNER

IJAHAH: IJAZAH SARJANA MUDA

SAYA: TEO MUN YEE

(HURUF BESAR)

MENGAKU MEMBENARKAN TESIS ini disimpan di Perpustakaan Universiti Malaysia Sabah dengan syarat-syarat kegunaan seperti berikut:

1. Tesis adalah hak milik Universiti Malaysia Sabah.
2. Perpustakaan Universiti Malaysia Sabah dibenarkan memiui salinan untuk tujuan pengajian sahaja.
3. Perpustakaan dibenarkan membuat salinan tesis ini sebagai bahan pertukaran antara institusi pengajian tinggi.
4. Sila tanda tangan (T)

SULIT

(Terdahulu maklumat yang berdarjah kecemasan atau kepentingan Malaysia seperti yang termaktub di AKTA RAHSIA RASMI 19/72)

TERHAD

(Mengandungi maklumat TERHAD yang telah ditentukan oleh organisasi/lembaga di mana Penyelidikan dijalankan)

TIDAK TERHAD

PERPUSTAKAAN

UNIVERSITI MALAYSIA SABAH

Dizahak oleh: NURULAIN BINTI ISMAIL

LIBRARIAN

(TANDATANGAN PENULIS)

(TANDATANGAN PUSTAKAWAN)

Alamat tetap: NO 60, LEBIH BERCHAM

(TAMAN RIMA GAMELAN)

34000 JOH, PERAK.

CHEE FUEI PIEN

NAMA PENYELIDIK

Tarikh: 15/6/15

Tarikh: 15/6/15

Catatan: * Potong yang tidak berkenaan.

* Jika tesis ini SULIT atau TERHAD, sila lampirkan surat daripada pihak berkuasa/organisasi berkenaan dengan menyatakan sekali sebab dan tempoh tesis ini perlu diklasifikasi sebagai SULIT dan TERHAD.

* Tesis dimaksudkan sebagai tesis bagi Ijazah Doktor Falsafah dan Sarjana Secara penyelidikan atau disertai bagi pengajian secara kerja kursus dan Laporan Projek Sarjana Muda (LPSM)
DECLARATION

I am sure that this thesis is depends on my own effort, except for the information in those materials referred to which are cited in the reference section.

TEH MUN YEE
(BS 12110663)
1st JUNE 2015
CERTIFIED BY

1. SUPERVISOR
   (DR. CHEE FUEI PIEN )

2. EXAMINER
   (MDM. SATURI BINTI BACO)

Signature

iii
ACKNOWLEDGEMENT

I would like to impress my sincere gratitude to my supervisor Dr. Chee Fuei Pien who provided insight and expertise that greatly assisted this project. Her enthusiasm and patient give me comments that greatly improved the manuscript and can help me complete this project successfully. Hence, I can gain much knowledge on this study and understand this software.

Besides that, I would like to thank my friend for sharing their knowledge, experience and intellect which can bring me to success in this project. Moreover, I would also like to take this opportunity to give thanks to all the lectures that had given me useful insight and shared precious opinions, these information's and advices have been very helpful to me. The seniors that had provide me a great guidance and help to compensate for my lack of understandings with their past experience, thank you.

Finally, I would like to express my deepest gratitude to my parents for their fully support and encouragements.
ABSTRACT

Several wound evaluations are developed based on the change of color and wound size (surface area). Most of the wounds may have an overlying layer of black necrotic, yellow slough or red granulation tissue. During the wound healing process, wound color changes from black to yellow and finally red. In this case, it is clear that from inspection of Red, Green and Blue plane intensity-level histograms for the different tissue in the wound. For the surface area of wound, it can be determined from wound tracings and photography. In this wound scanner, wound area data (changes of area) is generated using the comparison between two images taken at an earlier time and later time. This wound scanner combines two features analysis methods which are: color-based and size-based in order to increase the accuracy of monitoring wound healing process. The analysis is presented in both graph and pie chart from which give the user a clear illustration on the rate of recovery of their wound. The wound information can be stored accurately as the file name has information about date and time for future references. In conclusion, the software has been successfully developed to provide a simple and easy solution in monitoring the wound recovery rate.
PENGIMBAS LUKA YANG MUDAH DAN PINTAR

ABSTRAK

# LIST OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>DECLARATION</td>
<td>ii</td>
</tr>
<tr>
<td>CERTIFIED BY</td>
<td>iii</td>
</tr>
<tr>
<td>ACKNOWLEDGEMENT</td>
<td>iv</td>
</tr>
<tr>
<td>ABSTRACT</td>
<td>v</td>
</tr>
<tr>
<td>ABSTRAK</td>
<td>vi</td>
</tr>
<tr>
<td>LIST OF CONTENTS</td>
<td>vii</td>
</tr>
<tr>
<td>LIST OF TABLES</td>
<td>x</td>
</tr>
<tr>
<td>LIST OF FIGURES</td>
<td>xi</td>
</tr>
<tr>
<td>LIST OF ABBREVIATION</td>
<td>xiii</td>
</tr>
</tbody>
</table>

## CHAPTER 1  INTRODUCTION

1.1 Research Background 1

1.2 Objective 2

1.3 Scope 2

1.4 Hypothesis 3

## CHAPTER 2  LITERATURE REVIEW

2.1 Introduction 4

2.1.1 Wound 4

2.1.2 Wound Healing 5

2.2 Effects on Untreated Wound 6
2.3 Factors Affecting Wound Healing
   2.3.1 Local Factors that Influence Healing
   2.3.2 Systemic Factors that Influence Healing
2.4 Image Processing in MATLAB
2.5 The Trend and Progress of Wound Scanner
   2.5.1 Fotoscan 3D
   2.5.2 Portable Optical Wound Scanner
      2.5.2.1 Brief Description of the Optical Wound Scanner Structure
2.6 History of Wound Scanning Technology
2.7 Research Direction

CHAPTER 3 METHODOLOGY

3.1 Introduction
   3.1.1 Flow Chart of the Scanning Process
3.2 Development of Software
   3.2.1 Software Development using MATLAB
   3.2.2 Graphical User Interface (GUI)
   3.2.3 Flow Chart of the Developed Software
3.3 Image Processing
   3.3.1 Fundamental Steps of Digital Image Processing
   3.3.2 Flow of Wound Scanning Processing
### CHAPTER 4  RESULTS AND DISCUSSION

<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.1</td>
<td>Introduction</td>
<td>31</td>
</tr>
<tr>
<td>4.2</td>
<td>Software Interface</td>
<td>31</td>
</tr>
<tr>
<td>4.2.1</td>
<td>Program Flow of Wound Scanner</td>
<td>32</td>
</tr>
<tr>
<td>4.2.2</td>
<td>Image Analysis</td>
<td>35</td>
</tr>
<tr>
<td>4.2.3</td>
<td>Output of Wound Scanner</td>
<td>37</td>
</tr>
<tr>
<td>4.3</td>
<td>Software Testing</td>
<td>40</td>
</tr>
<tr>
<td>4.3.1</td>
<td>Case Study 1 on First Sample</td>
<td>40</td>
</tr>
<tr>
<td>4.3.2</td>
<td>Case Study 2 on Second Sample</td>
<td>41</td>
</tr>
<tr>
<td>4.4</td>
<td>Output of Wound Scanner</td>
<td>42</td>
</tr>
</tbody>
</table>

### CHAPTER 5  CONCLUSION AND RECOMMENDATION

<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.1</td>
<td>Conclusion</td>
<td>45</td>
</tr>
<tr>
<td>5.2</td>
<td>Recommendation</td>
<td>45</td>
</tr>
</tbody>
</table>

REFERENCES

APPENDIX A
# LIST OF TABLES

<table>
<thead>
<tr>
<th>Table No.</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1</td>
<td>Factors affecting wound healing.</td>
<td>8</td>
</tr>
<tr>
<td>4.1</td>
<td>Table for comparison in different features on the sample1 and sample2.</td>
<td>44</td>
</tr>
<tr>
<td>Figure No.</td>
<td>Description</td>
<td>Page</td>
</tr>
<tr>
<td>-----------</td>
<td>------------------------------------------------------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>2.1</td>
<td>Phases of cutaneous wound healing.</td>
<td>5</td>
</tr>
<tr>
<td>2.2</td>
<td>Plan view of the scanning device of the present invention.</td>
<td>14</td>
</tr>
<tr>
<td>2.3</td>
<td>Plan view of the scanning device.</td>
<td>15</td>
</tr>
<tr>
<td>2.4</td>
<td>Perspective view of the scanning device of the present invention.</td>
<td>15</td>
</tr>
<tr>
<td>2.5</td>
<td>Perspective views of a light source, an optical means, a sensor means, and an imaging means.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>16</td>
</tr>
<tr>
<td>2.6</td>
<td>Schematic drawing showing various paths of light produced in use of the light source, optical means, sensor means, and imaging means.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>16</td>
</tr>
<tr>
<td>2.7a</td>
<td>Perspective view of the scanning of a wound and surrounding reference plane with a line of light produced.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>17</td>
</tr>
<tr>
<td>2.7b</td>
<td>Schematic view of a two dimensional pixilated sensor array.</td>
<td>17</td>
</tr>
<tr>
<td>2.8</td>
<td>Embodiments that includes a one-dimensional sensor in combination with the imaging means and scanning mirror.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>18</td>
</tr>
<tr>
<td>3.1</td>
<td>Flow chart of scanning process.</td>
<td>21</td>
</tr>
<tr>
<td>3.2</td>
<td>Simple graphical user interface.</td>
<td>23</td>
</tr>
<tr>
<td>3.3</td>
<td>Flow Chart of the expected outcomes.</td>
<td>25</td>
</tr>
</tbody>
</table>
3.4 Fundamental steps of digital image processing.

3.5 Example of wound scanning process of the project
   a) Original RGB colour image of a wound on foot, from a user at first visit.
   b) Grey scale image of the wound
   c) Normalized image of the wound
   d) Binarised image of the wound
   e) Contour matrix of the binary wound image
   f) Final segmentation of the wound by snakes
   g) Segmented wound
   h) Histogram of the segmented wound

4.1 Interface of wound scanner using Graphical User Interface (GUI)

4.2 Interface of software testing on sample1

4.3 Interface of software testing on sample1 on fifth day

4.4 Interface of software testing on sample2

4.5 Interface of GUI testing on sample2 in third day

4.6 Interface of GUI testing on sample1 in fifth day

4.7 Interface of GUI testing on sample2 in third day
# LIST OF ABBREVIATIONS

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>DHT</td>
<td>Dihydrotestosterone</td>
</tr>
<tr>
<td>DHEA</td>
<td>Dehydroepiandrosterone</td>
</tr>
<tr>
<td>HPA</td>
<td>Hypothalamic-pituitary-adrenal</td>
</tr>
<tr>
<td>DFUs</td>
<td>Diabetic foot ulcers</td>
</tr>
<tr>
<td>NSAIDS</td>
<td>Nonsteroidal anti-inflammatory drugs</td>
</tr>
<tr>
<td>ROI</td>
<td>Regions of interest</td>
</tr>
<tr>
<td>RGB</td>
<td>Red-green-blue</td>
</tr>
<tr>
<td>3D</td>
<td>Three-dimensional</td>
</tr>
<tr>
<td>MRI</td>
<td>Magnetic resonance imaging</td>
</tr>
<tr>
<td>MRS</td>
<td>Magnetic resonance spectroscopy</td>
</tr>
<tr>
<td>SEM</td>
<td>Scanning electron microscopy</td>
</tr>
<tr>
<td>2D</td>
<td>Two-dimensional</td>
</tr>
<tr>
<td>GUI</td>
<td>Graphical user interface</td>
</tr>
<tr>
<td>DIP</td>
<td>Digital image processing</td>
</tr>
<tr>
<td>PC</td>
<td>Personal computer</td>
</tr>
<tr>
<td>ID</td>
<td>Identity card</td>
</tr>
</tbody>
</table>
CHAPTER 1

INTRODUCTION

1.1 Research Background

Wound healing is a complicated process where the skin can repair by itself after injured. Wound healing can be divided into four phases (Mercandetti et al., 2005). In the haemostasis phase, the blood changes from a liquid into a gel. For our skin, the both of epidermis (outermost layer) and dermis (inner layer) are in equilibrium. These layers will form a protection barrier with the help of platelets which can avoid bleeding continuously (coagulation factor). Hence, it can protect the epidermis and dermis from external environment. In the inflammation phase, the platelets are accumulated to form a clot of fibrin which can block the bleeding blood vessels. After that, the platelets will release cytokines to activate the stage of inflammation. The migration of white blood cells helps to remove the dead and dying cell. Once bleeding has stopped, the process of proliferation has been activated. The creation of new blood vessels (Angiogenesis) and the formation of granulation tissue occurred. For the final remodelling phase, the collagen is remodelled and rearranged more parallel to the wound (Orgill et al., 2009).

A wound scanner is necessary in the wound healing. There are few classifications on the wound scanner. The wound scanner can scan and analyse the wound. The details of the wound healing can be divided into few groups which are colour, area and the percentage of recovery of the wound. However, it would be hard for the patients always go to the hospital for checking their wound. Moreover, the patients also need to spend much money for the re-examination by the doctor. Some of the patients may not clear about their wound condition. This motivates this
research to design a software in MATLAB to run the process of scanning the wound
by using webcam. This software will show the information and condition about the
injury after the scanning process. The data showed should be easily understood by
the patient and the treatment can be applied in as soon as possible if needed.

For the advantages of the wound scanner by using webcam, it is objective
and save time. It really lowered the cost of care through the detection and provides
institutions with a powerful risk management tool. Furthermore, it is usable for
patients of all ages. Moreover, the program will record the data of the injury. The
wounded can show the data to the doctor for extra information. Particularly for the
diabetics, they can use this software to scan their wound every day and anywhere. It
is a device for long term care. Through this model, everyone can afford to monitor
their wound-healing process at a more convenient way in term of time and cost-
saving on it.

1.2 Objective

The objective of this project which is stated as below:

- To design and create a program to scan and analyse the wound.
- To photograph the wound by using the camera in smart phone or laptop.
- To show the percentage of recovery of the wound according to its colour and
  area. These will be scanned by using this program.

1.3 Scope

The scope of my project is to design and develop a program for a scanner which can
scan or detect the trauma according to its colour, area and the rate of recovery. My
research can scan and analyse any types of the wound by using the webcam. Hence,
everyone can use this software through their laptops to scan their wounds
immediately and can apply the right treatment accordingly.
1.4 Hypothesis

After the program can run successfully, the scanner can scan the wound on any part of the body. It can shows the information and the percentage of recovery to the users. This function can be run through laptop. Hence, everyone can use it to scan their wound to analyse the condition of their injuries.
CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

2.1.1 Wound

Wound is the damage in the protective barrier of the skin, which is torn, cut, burned, bruised or punctured. This can happen relatively quickly. Moreover, it is an injury that caused by surgery, a blow, a cut, chemicals, heat, cold, friction or shear force, and pressure or as a result of disease, such as ulcers or carcinomas in level 3. The loss of continuity in any body tissue causes the epidermis cannot recover at once (Enoch S and Price P, 2004).

Wound can be classified into two main types which are open and closed wound. One of the types of open wound is the Incised wound which is caused by a sharp object for instance a knife or glass. Bruise is a superficial wound in which the epidermis is scraped off and it is usually caused by the friction between the skin and rough surface. Avulsion is a type of dangerous injury in which a body structure be compelled to detach from its normal point if insertion. It is a type of amputation. A puncture wound is caused by an object puncturing the skin, for example a nail or needle. The other type of the open wound is a penetration wound. It is caused by a sharp object entering and coming out from the skin.
For the closed wound, it has fewer categories. One of the types is blood tumor (Hematomas) caused by the damage of the blood vessel so the blood is collected under the skin. Another type of closed wound is crush injury which is caused by a great or extreme amount of force applied over a long period of time.

2.1.2 Wound Healing

Wound healing is a complex process where the skin recovers itself automatically after injury (Nguyen et al., 2009). Normally wound healing process has four principal phases which are hemostasis, inflammatory, proliferative and remodeling. The epidermis and dermis form a protective barrier of our body to against the external environment.

![Figure 2.1 Phases of cutaneous wound healing](http://tube.medchrome.com/2013/04/stages-and-process-of-wound-healing.html)
In the hemostasis phase (coagulation), the constriction of the blood vessels occurs to reduce the blood flow to the affected area. This activates the platelets to cause blood clotting and the formation of fibrin network occurred. Therefore, the clot can prevent the active bleeding. After that, platelets release cytokines, histamine and serotonin which activate the second phase of healing, inflammation.

In the inflammation phase, the activation of neutrophils is started. Neutrophils is a type of phagocyte, they phagocytize the foreign bodies. They are the most abundant cells in the first 24 hour period. Hence, the bacteria and cell debris are phagocytized and then removed from the wound by white blood cells (PMN).

After that, the formation of granulation tissue begins and the vascular endothelial cells generate the new blood vessels (Angiogenesis) by 48 hours. The depositions of type III collagen fibers take place. All of these are included in proliferation process. In this process, the fibrin clot is dissolved while enzymes are released and phagocytosis continues. The greatest increase in wound strength occurs during this phase.

For the final remodeling phase, the type III collagen will be converted to type I collagen which collagen bundles are larger. Those collagen fibers interlinked increasingly and replaced with more organized collagen that is better arranged to resist mechanical stress. Thus, the tensile strength will increase. However, the strength of the new collagen is lower compared to the strength of uninjured collagen.

2.2 Effects on Untreated Wound

Any skin injury is at risk of becoming infected. If a wound does not get a correct treatment, it may have the chance to get wound infection. Wound infection occurs when bacteria from the environment enters an open wound, for instance cut, scrape, bruise or puncture wound. If left untreated, the infection may spread to other parts of the body. This may result in the loss of function or amputation, and can be dangerous.
While deep cuts are contaminated, the cuts have higher chance to be infected. Even for the well taken care of the small scratches can also become infected. There are some common wound infection symptoms, such as swelling, redness, discharge, and pain. Swelling is the more common symptoms of wound infection. The swelling that lasts for more than three to five days would be indicated as infection. Normally, the swelling will go around the wound area and it will look red. This swelling will typically be hot or warm to the touch.

Redness around a wound site is considered as less serious infection. Red streaks that run away from the wound site towards the lymph nodes. However, it can be a sign of a serious infection. The infection of lymph vessels (Lymphangitis) often caused by the streptococcal or staphylococcal bacteria. Therefore, prompt medical attention is strongly advised. If not treated immediately, it leads to sepsis.

Discharge from the wound site often referred as pus, can be cloudy, yellowish, or greenish, and it may have a very foul smelling. This substance is normally a combination of dead skin cells, white blood cells, and bacteria. It is a way of attempting to remove the infection from the body. Pus that trapped below the surface of the skin can form an abscess.

Pain around the wound site is the common wound infection symptoms. A burning pain might be strongly felt on and around the wound site. Some pain is expected with many types of wounds, but pain that intensifies instead of lessens as time goes by is typically a sign of infection. The pain is often accompanied by swelling, redness, and pus (Gardner et al., 2001).

2.3 Factors Affecting Wound Healing

Many factors can interfere the rate of wound healing. The factors that influence recovery can be categorized into local and systemic. Local factors are those directly affect the feature of the wound itself, while systemic factors are the overall health or disease state of the individual that affecting the recovery speed of the patient to heal (Table 2.1).
Table 2.1 Factors Affecting Wound Healing (Mathieu et al., 2006)

<table>
<thead>
<tr>
<th>Local Factors</th>
<th>Systemic Factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oxygenation</td>
<td>Age and gender</td>
</tr>
<tr>
<td>Infection</td>
<td>Sex hormones</td>
</tr>
<tr>
<td>Foreign body</td>
<td>Stress</td>
</tr>
<tr>
<td>Venous sufficiency</td>
<td>Ischemia</td>
</tr>
<tr>
<td></td>
<td>Diseases: diabetes, keloids, fibrosis, hereditary healing disorders, jaundice, uremia</td>
</tr>
<tr>
<td></td>
<td>Obesity</td>
</tr>
<tr>
<td></td>
<td>Medications: glucocorticoid steroids, non-steroidal anti-inflammatory drugs, chemotherapy</td>
</tr>
<tr>
<td></td>
<td>Alcoholism and smoking</td>
</tr>
<tr>
<td></td>
<td>Immunocompromised conditions: cancer, radiation, AIDS</td>
</tr>
<tr>
<td></td>
<td>Nutrition</td>
</tr>
</tbody>
</table>

2.3.1 Local Factors that Influence Healing

- **Oxygenation**

Oxygen is an important role for metabolism as it will directly affect all the wound healing processes. It helps to avoid wounds from infection, lead to angiogenesis, and re-epithelialization, enhances collagen synthesis, promote wound contraction (Rodriguez et al., 2008). Lack of oxygen or decreased circulation can slow down the progress of wound healing.

- **Infection**

Once the protective barrier of skin is damaged, microorganisms obtain access to the underlying tissues. The state of infection and replication of the microorganisms decide whether the wound is differentiated as having contamination, colonization, local infection, or spreading invasive infection. Contamination is the presence of non-replicating microorganisms on a wound. On the contrary, the colonization is defined as the presence of replicating microorganisms on the wound without tissues damage. Local infection is an intermediate stage, with microorganism replication and the beginning of local tissue responses. Invasive infection is defined as the presence of
replicating organisms within a wound with subsequent host injury (Edwards and Harding, 2004). If an infection is present, as evidenced by purulent drainage or exudate, induration, erythema, or fever, a wound culture should be obtained to identify the offending bacteria and antibiotic therapy is needed.

2.3.2 Systemic Factors That Influence Healing

• Age

Age plays a significant role in the time it takes and the ability for a wound to heal properly. Seniors may take longer time to recover as their skin show sign of reduced elasticity. The ability of the immune system decreased with the increasing of age (DiPietro et al., 2010). As the immune system of the seniors deteriorates, evidenced by the fibroblast and macrophage impairment, it will affect the function of wound healing. Older patients may have inadequate nutritional intake, altered hormonal responses, and poor hydration, any of which can increase the risk of skin breakdown and delay wound healing.

• Sex hormones

Sex hormones play a role in age-related wound-healing. Aged males are shown to have delayed healing of wound when compared with aged females. The female estrogens (estrone and 17β-estradiol), male androgens (testosterone and dihydrotestosterone, DHT), and their steroid precursor dehydroepiandrosterone (DHEA) appear to have significant effects on the wound-healing process. Estrogen can improve the age-related impairment in healing for both male and female, while androgens regulate cutaneous wound healing negatively (Gilliver et al., 2007).

• Stress

Stress has a significant impact on human health. Many diseases, such as cardiovascular disease, cancer, wound healing, and diabetes are related with stress. Numerous studies have confirmed that stress-induced disruption of neuroendocrine immune equilibrium is consequential to health (Glaser and Kiecolt-Glaser, 2005).
pathophysiology of stress results in the deregulation of the immune system, mediated primarily through the hypothalamic-pituitary-adrenal (HPA) and sympathetic-adrenal medullary axes or sympathetic nervous system (SNS) (Godbout et al., 2006).

- **Diabetes**

  Diabetes mellitus is a type of the chronic diseases that can compromise wound healing. Diabetic individuals show documented impairment in the acute wound healing. Moreover, this population is prone to develop chronic non-healing diabetic foot ulcers (DFUs), which are estimated to occur in 15% of patients with diabetes. DFU is a serious complication of diabetes, and precede 84% of all diabetes-related lower leg amputations (Brem and Tomic-Canic, 2007). Patients with diabetes should be followed closely through their course of care to provide the best plan.

- **Obesity**

  The problem of obesity continues to increase among adults, children and adolescents. Obesity shows the increment of risk in many diseases and health conditions, which include coronary heart disease, cancer, respiratory problems, and impaired wound healing. Obese individuals face wound complications frequently; including skin wound infection, pressure ulcers and venous ulcers (Wilson and Clark, 2004).

- **Medications**

  Steroid is one of the examples of medications. High dose of steroid can suppress both inflammation and immune system. Steroids can decrease the synthesis of collagen and affect its strength. Chemotherapy is designed to destroy cells and is always hazard to healing. Nonsteroidal anti-inflammatory drugs (NSAIDS) have also been implicated in a delay in wound healing. This is because NSAIDS have the anti-inflammatory effect.
REFERENCES


